

SUMMARY OF SUBMISSIONS AND RESPONSES
DRAFT SAFETY GUIDE ON MANAGEMENT OF NATURALLY OCCURRING RADIOACTIVE MATERIAL (NORM)

SUBMITTER	COMMENT	RESPONSE
<p>01 Nick Tsurikov Calytrix Consulting Pty Ltd</p>	<p>Please find enclosed my comments on the draft NORM guide. One of the main points is in comment 12 (1 Bq/g may be too high, and uncertainty if 0.3 or 1.0 mSv/year should be THE level). My comments there would apply to the amendments to the NDRP as well, but probably my concerns would be answered by the footnote 7 of the NDRP draft (about appropriate authority being able to impose requirements for reporting and monitoring, despite granting an exemption).</p> <p>Also – could you please let me know when (and if) it is planned to have annexes for titanium pigment and zircon. After all, I’m a ‘contributor to drafting and review’ of IAEA safety reports on the same issues, and should be able to provide a lot of info. I am also currently involved with rare earth operation in WA (with expansion to Malaysia) and would probably be involved in another one, in NT (but they have not even commenced construction yet...) – I may be able to help with the annex on ‘lanthanides’, if this ever would be considered.</p> <p style="text-align: right;"><u>Attachment</u></p> <p style="text-align: center;"><u>Comments on the draft NORM Safety Guide</u> (Consultation draft: 2 May 2008)</p> <p>Thank you very much for the opportunity to comment on the draft document.</p> <p>I would like to offer the following comments for your consideration:</p> <p><u>Comment 1</u></p> <p>Parts 2.8.1 (Titanium dioxide pigment production) and 2.8.2 (Zircon refining). It may be worthwhile to reference relevant IAEA Safety Reports, similarly to the part 2.1 (Oil and gas industry): Safety Report</p>	<p>See comment 12 response</p> <p>Noted. No dates for additional Annexes have been considered at present.</p> <p>SR-34 (oil & gas) is already referenced. SR 51 (zircon) has been included</p>

	<p>No.51 (on zircon industry, 2007) and a similar report on Titanium pigment industry that is expected to be officially published in the next month or two.</p> <p><u>Comment 2</u></p> <p>Lines 289-692, part 2.10 – Water treatment. It is correct that Ra²²⁸ concentrations tend to be higher than those of Ra²²⁶, this however may not be the case in the areas of wide-spread and prolonged fertilizer application, particularly if the fertilizer was an imported one.</p> <p><u>Comment 3</u></p> <p>Line 781, part 3.2.1– Internal exposures. A misprint: Thoron is actually Rn²²⁰, not Rn²²² as in the text.</p> <p><u>Comment 4</u></p> <p>Lines 917-918, part 3.3.3 – Dredging for mineral extraction. I would suggest to insert after “...transport.” in line 918 the following: <i>The most common practice is pumping the slurry directly to the concentration plant located in the vicinity of the dredge.</i></p> <p><u>Comment 5</u></p> <p>Line 961, part 3.4.3 – Radon. I would suggest changing the word “are” to “may be” in the sentence “Therefore the decay products are the major radiological issue...”, as this is not always the case (example of downstream processing of zirconium and titanium minerals).</p> <p><u>Comment 6</u></p> <p>Lines 976-977, part 3.5 – Transport of bulk commodities.... The reference to the IAEA Safety Guide RS-G-1.7 should be deleted from this part as it is specifically stated that this Guide does not apply to transport situations (please see paragraph 1.8 on page 4 and footnote 8 on page 17 of the RS-G-1.7).</p>	<p>Not relevant to water treatment plants</p> <p>Agreed and amended</p> <p>Amended</p> <p>Will include “In most situations....”</p> <p>Agreed and amended</p>
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	<p><u>Comment 7</u></p> <p>Lines 1028-1033, part 3.6 – Use of products. I would argue that ceramic tiles are also extensively used in offices and in residential dwellings (not just in bathrooms and toilets). Whilst the dose rate at a distance of 1 meter from the tiled floor/wall is, indeed, the same as the general background – the surface gamma-radiation readings can be in the range between 0.2 and 0.6 microGrays per hour, which is significantly higher than the background.</p> <p><u>Comment 8</u></p> <p>Line 1137, part 3.8.1 – Storage. Probably insert after "...buildings,": <i>or specifically designed pits at mine sites.</i></p> <p><u>Comment 9</u></p> <p>Lines 1150-1153, part 3.8.2 – Near surface burial. Probably insert somewhere in this paragraph that specific conditions would need to be placed on a land title such as, for example, - "no excavations deeper than 3 meters".</p> <p><u>Comment 10</u></p> <p>Lines 1156-1157, part 3.9 – Public perception. The statement about 'traditional public perception' appears to imply that this perception may be wrong. This may be in contradiction to a 'standard Annex' to RPS publications (Annex B in RPS-9, for example), where it appears that there is no safe threshold of radiation exposure. It would be beneficial to clarify this, or delete the sentence about 'traditional perception' all together – particularly in the light of the ARPANSA statement that "there is some epidemiological evidence that there are risks to health from lower doses of radiation, down to 20 mSv" REF: (a) Committee Hearing, 16 September 2005, Sydney, pp.2-6.</p>	<p>Have included kitchens on list – which is intended to cover such areas in residential dwellings and offices etc.</p> <p>This is correct, but the time spent in close proximity to walls and floors is generally small. Background external dose is usually measured at a height of 1 metre above the ground surface. The dose at the ground surface may be considerably higher</p> <p>Agreed. Will add "purpose-designed pits ..."</p> <p>Added "and if necessary, restrictions should be placed on the use of the land."</p> <p>Edited this paragraph to clarify that public perception often interprets low levels of exposure as having consequences similar to Chernobyl or Hiroshima.</p>
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	<p>Australia's Uranium – Greenhouse friendly fuel for an energy hungry world, The Parliament of the Commonwealth of Australia, House of Representatives, Standing Committee on Industry and Resources, Canberra, November 2006), and</p> <p>(b) Submission No.32 (ARPANSA), to the same committee.</p> <p><u>Comment 11</u></p> <p>Lines 1161-1163, part 3.9 – Public perception. A reference to the following IAEA document will be very useful, in my opinion: Communications on nuclear, radiation, transport and waste safety: a practical handbook, IAEA-TECDOC-1076, April 1999.</p> <p><u>Comment 12</u></p> <p>Lines 1275-1279, and the whole part 4.3.1 – Application of exclusion and exemption to NORM It may be that the level of 1 Bq/g would be picked up as a 'screening level' (line 1283). It would be probably worthwhile to emphasize more clearly that after 'human activities' commence (lines 1280-1281), the exemption is to be based on the dose level, not on the concentrations of radionuclides.</p> <p>Detailed comment on lines 1275-1279 (similar comments were provided for the IAEA Safety report No.49 on assessing the need for radiation protection): The footnote 8 on the page 21 of IAEA Basic Safety Standards (1996) is still valid and should be taken into account. It states: "Clearance of bulk amounts of materials with activity concentrations lower than the guidance exemption limits specified in Table I-I of Schedule I may require further consideration by the Regulatory Authority".</p> <p>An example to illustrate the case in question:</p> <ul style="list-style-type: none"> - Bulk amount of material containing 0.8 Bq/g of Th232 (say, 10-20 Kt, in equilibrium with decay products – for simplicity) would clearly be exempted in accordance with the IAEA RS-G-1.7 and the reviewed draft Guide. 	<p>Amended to include reference</p> <p>This section has been amended in response to this and other submissions</p> <p>Covered in lines 3701-3707</p>
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	<ul style="list-style-type: none"> - Let us consider a medium case, where this material is not used as a landfill for residential areas but, say, in the area where some offices/workshops will be constructed (exposures – 2000 hours in a year). - Table 6 on p.116 of Vol.1 of UNSCEAR-2000 report provides the coefficients to convert Bq/g to likely dose rate level in microGrays per hour. In case of Th²³² it is 0.604 [microGy/hr]/[Bq/g]. The expected dose rate would be, therefore, in order of 0.48 microGy/hr. The typical background level is around 0.10 microGy/hr – that leaves 0.38 microGy/hr “extra”. Taking into account that these gammas would be ‘environmental low-energy’ ones (debatable, but let’s assume they are) – the ‘excess’ dose rate would be 0.27 microSv/hr. <p>This results in an annual exposure over 2000 hours of 0.54 mSv. The value is clearly below 1 mSv/year limit but higher than the dose constraint of 0.3 mSv/year referred to below.</p> <p>If the same material is used in a residential landfill, exposures would be in order of 1.35-1.62 mSv/year (based on 5000-6000 hours).</p> <p>Therefore, the statement on lines 1277-1278 that “under these conditions, it can be anticipated that doses to members of the public will be less than 10 microSv/year” is clearly incorrect.</p> <p>Given the potential of ‘uncontrolled release’ of material described above to the general public and the dose constraint of 0.3 mSv/year established in the referred (lines 2226-2228) IAEA Safety Guide WS-G-5.1 (page 6), I would suggest inserting a modified text of the footnote from IAEA Basic Safety Standards into the text of the Guide.</p> <p>It appears unclear what level should actually be used: 0.3 mSv/year or 1 mSv/year. Part 4.3.1 clearly refers to 1 mSv/year, this value is referred to in other parts of the draft Guide (lines 1618-1620, for example). Part 4.8, however, (lines 1684-1689) lists levels 0.1-0.3 mSv/year as the ones under which site can be released from regulatory control.</p>	<p>This paragraph has been deleted as it referred to artificial radionuclides rather than NORM</p> <p>The Safety Guide already indicates that assessment of particular situations is required, because of the dependence of dose on differing factors for different exposure scenarios (see section 3).</p> <p>Section 4.8 only refers to typical variations in natural background levels. The text of the final paragraph has been amended to give a clearer description of the factors to be considered.</p>
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	<p>There also appears to be an inconsistency between the comments to the Table 8 draft Guide and Table 2 in IAEA SR-49, from where this table is taken.</p> <p>The draft Guide states (lines 1377-1379): “Where the materials have activity concentrations of uranium and thorium series radionuclides not exceeding 1 Bq g⁻¹ they are unlikely to require further consideration unless they are used as building materials.”</p> <p>The IAEA SR-49, in the comment to the same table (p.23), states: “Work involving material below the activity concentration values in Table 2 might still require regulatory attention...”</p> <p>Of course, this would be (as IAEA suggests) a lower priority, but nevertheless potential exposures will need to be assessed.</p> <p><u>Comment 13</u></p> <p>Part 4.4.6 – NORM management plan (also lines where this term is mentioned: 1051-1052, 1458, 1495-1496, 1516-1517, 1584, 2042, 2093, 2096)</p> <p>The creation of the new term (<i>NORM</i> management plan) is unnecessary and would only create further misunderstandings – both for the industries and their customers, and for the general public.</p> <p>It is already difficult to explain why different limits are applicable for workers and the public, doses from radon and other natural sources, there are different levels/limits for the same radionuclide – depending on its origin, ‘natural’ and ‘artificial’, and so on. Therefore, the new term would only add more confusion, in my opinion.</p> <p>The suggestion is not to introduce this new term at all and have the ‘radiation management plan’ with some parts of waste management included.</p> <p>Furthermore, the creation of this term would most likely create a perception in some industries that any elevated radiation exposures are</p>	<p>Table 2 refers to concentrations which could lead to doses >10% of the dose limit, not exemptions. It also refers to 5 Bq/g not 1 Bq/g. The comment below Table 8 in the draft is referring to material below the exemption level, not material causing doses >10% of the dose limit.</p> <p>Amended to clarify that a NMP is only necessary in situations involving NORM, and which are within the scope of this Safety Guide (and for which there is no existing RMP or RWMP), and that the elements of RMP and RWMP would be included in a NMP</p>
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	<p>'NORM problem' and are not as serious as 'radiation problem'. For example, it could be concluded that a material such as zircon sand is less dangerous during its processing (such as micronisation and fusion) [NORM management plan] than inside mineral sands processing plants [radiation management plan] – where the opposite is, in fact, the case.</p> <p>An additional comment – whilst a single radiation management plan may be acceptable for a small or medium size enterprise, in the case of a complex mining/processing operation there may be a need to develop four different management plans, which would be unlikely from the practical point of view:</p> <p>Radiation management plan – mining and processing, Radioactive waste management plan – mining and processing, NORM management plan – downstream processing of some minerals, and Transport management plan – describing how all materials are transported between different sites/plants.</p> <p><u>Comment 14</u></p> <p>Whole part 4.9 – Assessing the impact of regulatory proposals and lines 1712-1714 in particular – the term of 'self-regulatory' approach.</p> <p>The term of 'self-regulation' is unacceptable in radiation protection legislation and should be either removed or replaced with 'performance-based regulation'.</p> <p>The following are the quotes from National Competition Policy Review of Radiation Protection Legislation, Final report, ARPANSA, 2001.</p> <p>It was recommended (page 7) that:</p> <p>"...the achievement of radiation protection objectives will be well served by retaining the general prescriptive approach found in the radiation protection legislation..."</p> <p>"Alternatives such as "negative licensing" or "self regulation" are neither desirable nor feasible."</p>	<p>The Guide clearly states that it does not cover mineral sand processing, as this is already subject to regulation, but does deal with downstream processing</p> <p>1520-1524 is intended to convey that a separate NMP is not required where a RMP is already in place. The text has been edited to clarify.</p> <p>The Guide is not intended to apply to operations where a radiation management plan and/or radioactive waste management plan and/or transport management plan are already required by regulation.</p> <p>This section is a quote from the Best Practice Regulation Handbook, describing the principles of good regulatory process. This includes the need for consideration of other policy options such as self-regulation. While the NCP Review concluded that self-regulation was not appropriate for managing radiation hazards, this Safety Guide is examining areas where an assessment of the need for regulation is required. In this context, the costs and benefits of a range of policy options should be examined.</p>
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	<p>“Nevertheless, the Review Team has recommended that jurisdictions should, where appropriate, consider performance-based approaches for the regulation of radiation protection and radiation safety.”</p> <p>Furthermore, it is stated on pp.31-32 that:</p> <p>“Non-regulatory alternatives, such as “self-regulation” and “negative licensing” are not being considered.”</p> <p>“...the performance-based approach may be inappropriate for the activities of even large firms or corporations, which can afford to conduct their own risk assessment and management...”</p> <p>“...COAG makes reference to the fact that a prescriptive approach may be unavoidable in regulations that deal with public health and safety.”</p> <p><u>Comment 15</u></p> <p>Lines 2803-2804, part Glossary</p> <p>The definition of NORM appears to very vague and, in accordance with it, every material at every site/location may be classified as ‘NORM’. The suggestion is to replace this definition with the one from the Guideline on Classification of Radioactively Contaminated Sites (Radiological Council of Western Australia, 2007), which, in my opinion, offers much better description of materials to which this Guide is intended to apply:</p> <p>NORM (naturally occurring radioactive material) – Material containing no significant amounts of radionuclides other than naturally occurring radionuclides, disturbed or altered from natural settings, or present in technologically enhanced concentrations above background radiation levels due to human activities that may result in a relative increase in radiation exposures and risks to the public and the environment.</p> <p><u>Comment 16</u></p> <p>Lines 3304-3307, part Surface contamination</p>	<p>The intention is to deal only with those materials in which the radionuclide concentrations are changed as a result of human activities</p> <p>Amended definition to coincide with the IAEA Safety Glossary definition</p>
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	<p>It may be worth mentioning the existence of radiation monitors such as 'radioisotope identifiers', which could be helpful in on-site determination of what is in scale/slugde.</p> <p><u>Comment 17</u></p> <p>Lines 3341-3343, part A1.5.4 – Issues needing additional consideration The situation with equipment that is 'NORM-positive' off-shore and 'NORM-negative' on-shore is more or less easily addressed by the setting of company/industry standard for 'NORM-positive' levels.</p> <p>For example, general background levels are in order of 0.1 microSv/hour but can be up to 0.2-0.3 microSv/hour. Off-shore, these levels are naturally lower and typically would be in order of 0.02 microSv/hour. If the level from a piece of equipment is in order of 0.25-0.30 microSv/hour (off-shore and on-shore) – it is sufficiently low as to exempt this equipment from any control.</p> <p><u>Comment 18</u></p> <p>Lines 3708-2709, part A2.4 – Management strategies for each type of residue. Probably replace “represented in Figure 6” by “represented below” as it is not a 'figure' as such.</p> <p><u>Comment 19</u></p> <p>Lines 3710-3726, 3742-3747, part A2.4 – Management strategies for each type of residue. As detailed above (Comment 12), the value of 1 Bq/g may be inappropriate for bulk amounts of material and the value of 1 mSv/year may need to be replaced with 0.3 mSv/year.</p> <p><u>Comment 20</u></p> <p>Lines 3785-3788, 'the value of 0.3 mSv/year is considered in European Union'. This value is, in fact, in place in some countries in the EU for some time now and the reviewed Guide also recommends it as the level under which a site can be released from regulatory control (lines 1684-1689).</p>	<p>Agreed</p> <p>Agree that industry standards for 'NORM contaminated' are desirable; however, for the reasons given in Annex A, Section A1.5.3 'Monitoring', sub section 'External Radiation', the use of criteria based on external gamma levels is not supported."</p> <p>Agreed and amended</p> <p>The comments are consistent with the guidance given in the main part of the document. Some changes have been made to A2.4 as well.</p>
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	<p><u>Comment 21</u></p> <p>Annex 3 – Management of NORM in the phosphate industry It is not clear if phosphoric acid is actually produced in Australia and a clarification would be appropriate:</p> <p>Lines 3922-3924: “Phosphoric acid used industrially in Australia is now derived from imported material. For economic reasons, local production of phosphoric acid ceased in the early 1990’s [Chemlink]”.</p> <p>Lines 3992-3994: “To address this shift in demand favouring higher analysis fertiliser, certain Australian manufacturers are producing phosphoric acid to replace sulphuric acid.”</p>	<p>Text amended</p> <p>It is understood that phosphoric acid is no longer manufactured in Australia</p>
<p>02 Michelle Hendricks Principal Petroleum and Geothermal Environment Adviser Department of Primary Industries VIC</p>	<p>My comments on the discussion paper are as follows:</p> <ol style="list-style-type: none"> 1. The purpose of this Safety Guide is to assist regulators and industries in managing NORM and assessing the need for radiation protection measures, including regulation. 2. While the Guide is safety focussed, it describes the different strategies for management of NORM’s including disposal options and recommends an environmental impact assessment. 3. The Guide provides no specific criteria for discharge/disposal of NORM’s and no case studies. There is no mention of a trial currently being undertaken in Commonwealth waters off Western Australia regarding disposal of NORM’s. 4. The main issue for DPI, as a DA, is the disposal of NORM wastes and its environmental impacts. NORM wastes and their disposal must be outlined in the Environment Plan, as part of a risk based assessment. 5. Currently, Esso is the only operator whose disposal of NORM wastes is covered by an accepted Environment Plan. However, Esso has pre-approval from Gippsland Water to dispose of oily 	<p>Agreed</p> <p>Noted</p> <p>Each case has to be treated on its own merits. Criteria are set by legislation, regulations and codes of practice. Case studies can be found in the references and bibliography</p> <p>Noted</p> <p>Noted. The intention of the Safety Guide is to raise awareness and provide guidance that will assist in</p>

	sands containing NORM into engineered clay pits at the nearby onshore Dutson Downs facility. The Safety Guide does not impact on Esso's current arrangements.	considering the need for radiation protection measures (including regulation).
03 Peter Johnston Applied Physics School of Applied Sciences RMIT,	<p>I had a look through the NORM safety guide. I have no significant comments, but noted the following:</p> <ul style="list-style-type: none"> • p.6 line 194: do you mean tantalum or should it be titanium? • p.24 line 945: 'where it and can' – something wrong • p.42 line 1504: 'These instruments' – I would prefer another word than 'instruments' e.g. authorisations • p.82 line 2980 Error • p.101 line 3719: mSv a-1: last two characters should be superscript • p.102 line 3774: ARPANSA, 2008: list at back of RPS codes shows 2001 Transport code because list of RPS codes (p.115) has not been updated. 	<p>Yes it should be titanium - corrected Noted Agreed</p> <p>Reference to be corrected Agreed Agreed – to be fixed</p>
04 Prof Brian O'Connor Curtin University	<p>Principal Points</p> <p>The following features of the document are strongly endorsed.</p> <ol style="list-style-type: none"> 1. Emphasis on using a graded approach to NORM management 2. Guidance provided for the development of NORM management plans 3. Useful advice on dealing with public perception 4. Clear distinction drawn between residues and wastes 5. The iterative improvement approach to risk and impact assessment. 6. Comments on the use of computer modelling for dose assessments. This is especially important for radiological assessments in bauxite processing where the above-background potential doses are very small and often difficult to determine. 7. Handling of exemptions through a dual approach involving (i) unconditional exemptions which are likely to be pertinent to 	

	<p>public dose assessments in bauxite processing and (ii) conditional exemptions which are relevant to worker exposures.</p> <p>8. Adoption of the activity concentration unit Bq.g-1 unit rather than Bq.kg-1.</p> <p>I also support the rationale of the working party that mineral sands mining and primary processing be covered by the ARPANSA Code of Practice and Safety Guide RPS 9 Radiation Protection and Radioactive Waste Management in Mining and Mineral Processing and not by the NORM Safety Guide which focusses on the handling of relatively low activity materials.</p> <p>Corrections (Annex 2 on Bauxite)</p> <p>Page 94, line 3460: Change 18.3 Mt to 23.3 Mt. Page 94, line 3463. Change 44 Mt to 39 Mt. Page 99, line 3652. Change “residues arise” to “residues are those which arise” Page 99, line 3653. Change “ponds are” to “ponds. These are” Page 100, line 3675. Change “factor of two” to “factor of 2-3” Page 104 - (References, Annex 2): Penultimate reference, Change “Kühnasi” to “Kühnast”</p> <p>Editorial Points</p> <p>Pages 1-2. Query the empty boxes in the final column of Tables 1 – 4 Page 6, line 185. NORM should not be described as a contaminant. Delete “as a contaminant” Page 10, line 356. Insert space after “Summers et al,” Page 16, Table 5. Change “1.200 (wet)” to “1.20 (wet)” Page 42, line 1528. Change “mining code and safety guide” to “Mining Code and Safety Guide”</p>	<p>Noted</p> <p>Noted</p> <p>Annex to be amended to include these corrections</p> <p>Tables completed Agreed and amended</p> <p>Agreed and amended Agreed and amended Agreed and amended</p>
<p>05 Kevin Hedges - Senior Principal Occupational Hygienist (Northern Region) Qld Dept of Mines and Energy</p>	<p>My position is Senior Principal Occupational Hygienist with the Queensland Department of Mines and Energy (DME), Safety and Health (Mines Inspectorate). I have been in this role since August 2006. When I started, one of the issues encountered was that there was no clear guidance for NORM in exploration. Although the Code of Practice for Radiation Protection and Radioactive Waste Management in Mining and Mineral Processing http://www.arpansa.gov.au/pubs/rps/rps9.pdf does include exploration,</p>	

	<p>the information provided is not clear for exploration. To overcome this issue with the assistance of Mr John Kabel (Senior Mines Inspector) and grateful assistance from Queensland Radiation Health and Mr Mark Sonter, a guidance note was developed. See the attached file [PDF file - 05b - Kevin Hedges DME Qld - Exploration guidance_notes12.pdf].</p> <p>In my opinion, ARPANSA should consider NORM encountered in exploration as a separate category covered under this safety guide. This will promote and encourage national consistency.</p>	<p>Noted. The principles and guidance set out in this Safety Guide could be applied to the exposure scenarios which may arise in the mineral exploration industry (see Section 3). However the Radiation Health Committee may prefer to consider separate guidance on mineral exploration.</p>
<p>06 Peter Waggitt Consultant</p>	<p>I am not sure if this was sent previously or not so here goes anyway. I am basically OK with the document and think a good job has been done. These are my comments as a consultant rather than part of an IAEA response.</p> <p>Overall Comment: A good piece of work which is well structured and with plenty of references and an extensive bibliography. The reliance on IAEA publications, including the relevant Safety Reports and standards is clear and material has been used well. The link to other ARPANSA Codes, especially the Mining Code, is well explained and the difference in application is clearly shown.</p> <p>Line 537 Para 2.7 and onwards: As IAEA Safety Report 51 has been published now perhaps a simple reference to this document on Zircon industry could be inserted at some point and the reference list adjusted Radiation Protection and NORM Residue Management in the Zircon and Zirconia Industries Safety Reports Series No. 51</p> <p>Line 851: Sentence a bit awkward containing “use of the land” twice : ? The doses received will depend on the duration of exposure which in turn will be a function of the end use of the land</p>	<p>Noted</p> <p>Agreed. Reference added</p> <p>Agreed – sentence re-worded</p>

	<p>Line 953: Possibly also ingested whilst drinking (thumb in glass?) change to “eating and/or drinking”</p> <p>Line 1033: How about workers in tiled food stores, ceramic showrooms, older indoor swimming pools, hospitals, meat markets, etc??</p> <p>Line 1067: The cover need not only be clean soil. Probably better to say “a suitable cover of a suitable, clean material such as soil or un-mineralised rock.”</p> <p>Line 1079: Consideration should also be given to the environmental cost of disturbance at the source of supply, such as the destruction of another environment and inclusion of costs of the remediation of that site”</p> <p>Line 1121-24: Similar considerations here over the cover material supply costs in terms of environmental degradation at the excavation and the remediation of the borrow site.</p> <p>Line 1129: Maybe refer to residues from processing of NORM. Surely it is not just the NORM in its own right? “All wastes are residues but not all residues are waste” is certainly correct and this concept needs to be reinforced in this section</p> <p>Line 1149: “by” change to “as a result of “</p> <p>Line 1146: “Relating to” may be better expressed as “ with issues of”</p> <p>Line 1153: “.on the basis of environmental impact and safety assessments”. Or is it implicit that EIA includes Safety assessment?</p> <p>Line 1155: Public perception is always an issue (not just in the past!) rephrasing is recommended</p> <p>Line 1245: insert “or which” after whether</p> <p>Line 1990 et seq: Somewhere there should be a statement that the assumptions used in all modelling work must be clearly stated /</p>	<p>Agreed</p> <p>Text amended</p> <p>Agreed and amended</p> <p>Agreed and amended.</p> <p>Agreed and amended</p> <p>Agreed and amended</p> <p>Agreed and amended</p> <p>Agreed and amended</p> <p>Agreed and amended</p> <p>Agreed and amended</p> <p>Amended sentence to clarify</p> <p>Agreed – added extra dot point</p>
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	<p>announced with the results of the model for each run.</p> <p>Line 2016 - Also see below: "Rehabilitation" is not used in the IAEA Safety Glossary., nor is restoration or reclamation. Remediation is a better choice</p> <p>Line 2029: Section 6 might be better as 5.6. Or make 5.4 the start of Section 6 and number the following paragraphs 6.1, 6.2 and 6.3</p> <p>Line 2107: Perhaps change "benefits of" to "in" or "arising from" to avoid to "of" quite so close together?</p> <p>Line 2980/1: Some technical error.</p> <p>Line 3353: Change "oil" to "hydrocarbon"</p> <p>Line 3654: Storage? Surely this is disposal method, next sentence refers to "disposal areas"</p>	<p>Agreed and amended</p> <p>Remediation of legacy sites is not an operational issue. Amended the heading of 6 to clarify</p> <p>Agreed and amended</p> <p>Corrected</p> <p>Text amended</p> <p>Agreed and amended</p>
<p>07 Dr Graeme Dickie Chairperson Radiation Advisory Council (Qld)</p>	<p>Thank you for the invitation to comment on the Draft <i>Safety Guide for the Management of Naturally Occurring Radioactive Material (NORM)</i>. It is noted that this document has assembled data from a variety of sources and shows how widespread is the occurrence of NORM in products and wastes generated in industry. Our comments are as follows:</p> <ol style="list-style-type: none"> 1. In several places in the text (eg Tables 7 and 8) it is not clear whether the activity concentrations being reported are parent concentrations or total decay chain concentrations. The difference can be several fold. 2. The Safety Guide needs to be extended so as to provide clearer guidance for regulators and industry operators on a range of acceptable disposal options for various forms of NORM, and the conditions that might reasonably be attached to the approval of these disposal options. <p>The reason for this request is that there are some categories / types of NORM waste arising in industry, where sometimes, there is a lack</p>	<p>Table 7 heading refers to the highest radionuclide activity concentration. A note has been added to Table 8 to clarify.</p> <p>Noted, however only general guidance can be given in this Safety Guide. Detailed consideration of each proposal for disposal/management of wastes/residues is a matter for regulatory consideration, and will depend on a range of factors including the radionuclide content,</p>

	<p>of approved disposal options available. This lack of options has been, and continues to be, a significant commercial problem.</p> <p>With respect to disposal of NORM, it is not just the level of radioactivity in NORM, its physical and chemical form also needs to be considered.</p> <p>Material that is innocuous, chemically inert and insoluble, not particularly high in radionuclide content; any gamma dose increment above background can easily be eliminated via dilution and / or burial. Such situation could (it is proposed) be specifically cleared via the Safety Guide for disposal by burial, with or without dilution, with or without cover, in landfill, earthworks, or roadfill - essentially as clean fill.</p> <p>Material which cannot be shown to be insoluble will require a more constrained set of disposal options, possibly with a condition requiring immobilisation eg in cement.</p> <p>Some disposal options that might be applicable are:</p> <ul style="list-style-type: none"> • Free disposal to municipal tips or landfill • Use with or without dilution in construction fill, as roadbase or as a cement modifier • Disposal into mine waste rock dumps, smelter slag dumps, mine tailings dams or powerplant ashponds • Disposal into underground mine cemented backfill • Land application as soil conditioner • Injection with cement grout, or encapsulated, into old oil wells slated for abandonment and plugging <p>3. The <i>National Directory for Radiation Protection</i> has set the Exemption Limit for material containing U or Th at 1 Bq/g for the parent, i.e, head-of-chain. Below this level of concentration, material is categorically not to be regulated as radioactive, in other words it is regarded as non-radioactive.</p> <p>This figure translates to a total decay chain concentration of 14 Bq/g for materials containing uranium in equilibrium with its progeny, and</p>	<p>the form of the materials, site characteristics and the proposed disposal method.</p> <p>A Safety Guide is an advisory document and it is therefore not an appropriate place to state which materials should be specifically cleared or exempted – that is a regulatory decision dependent on a range of factors as indicated above</p> <p>Agreed and amended (see 3.8)</p> <p>While some of the options listed are re-use rather than disposal, the text has been amended (see 3.8) to include additional options</p> <p>Amended section 4.3.1 to clarify. Note that NDRP does not preclude the possibility of regulation being required below 1 Bq/g in certain circumstances (see NDRP section 3.2.4). This Safety Guide is consistent with NDRP.</p> <p>The Safety Guide emphasises the need for assessment</p>
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	<p>10 Bq/g for material containing thorium in equilibrium with its progeny. It is not clear what the situation should be with regard to radium scale, as found in the oil and gas industry. Clarification of this issue should be included in the Safety Guide.</p> <p>4. The ARPANSA <i>Code of Practice for the Safe Transport of Radioactive Material</i> gives an automatic relaxation of a factor of 10 (i.e. to 10 Bq/g of U or Th) for '<i>natural materials, and ores and concentrates containing U and Th, that are not intended to be processed for extraction of radionuclides</i>', on the basis of the inherently low risk of these materials.</p> <p>It is suggested that this relaxation should also apply to NORM materials, not only for transport but also for use and disposal. This clarification should be made in the Safety Guide.</p> <p>The dilemma of how to deal with disposal of NORM for industry and the regulatory implications would be greatly assisted if the Safety Guide were to provide clear guidance on the range of options, and suggest disposal plans which should receive acceptance by the regulators.</p>	<p>to take account of the specific situation, and in particular, careful specification of the concentration of the parent radionuclide and the degree of secular equilibrium.</p> <p>While the factor of 10 is appropriate for transport, due to the limited number of relevant scenarios, it may not be appropriate for a general exemption. The National Directory for Radiation Protection establishes the uniform exemption levels to be adopted in all jurisdictions, not this Safety Guide. The NDRP allows for flexibility in consideration of exemptions, including those cases where the concentration is above 1 Bq/g.</p> <p>Due to the nature and range of factors to be considered, it is not appropriate to suggest disposal plans and pre-empt regulatory processes via this Safety Guide. Disposal options and regulatory approaches can change as new information and/or technology becomes available</p>
<p>08 Michael Ison Policy and Research Australian Aluminium Council</p>	<p>The Australian Aluminium Council (AAC) has been consulted during the development of the draft through the involvement of Emeritus Professor Brian O'Connor as an AAC nominee on the working group which produced the draft.</p> <p>The Council wishes to express its appreciation for the truly collaborative manner in which the regulator and industry representatives on the working group have acted in producing a report which will sensibly guide regulators and industry on the management of NORM materials. We especially appreciate the way in which points raised with reference to NORM management in bauxite processing have been adopted.</p> <p>The AAC emphasises its strong support for the following features of the document.</p> <p>1. Emphasis on using a graded approach to NORM management</p>	<p>Noted, thank you.</p>

	<p>2. Guidance provided for the development of NORM management plans</p> <p>3. Useful advice on dealing with public perception</p> <p>4. Clear distinction drawn between residues and wastes</p> <p>5. The iterative improvement approach to risk and impact assessment.</p> <p>6. Comments on the use of computer modelling for dose assessments. This is especially important for radiological assessments in bauxite processing where the above-background potential doses are very small and often difficult to determine.</p> <p>7. Handling of exemptions through a dual approach involving (i) unconditional exemptions which are likely to be pertinent to public dose assessments in bauxite processing and (ii) conditional exemptions which are relevant to worker exposures.</p> <p>8. Adoption of the activity concentration unit Bq.g-1 unit rather than Bq.kg-1.</p> <p>The AAC also supports the rationale of the working party that mineral sands mining and primary processing be covered by the ARPANSA Code of Practice and Safety Guide RPS 9 <i>Radiation Protection and Radioactive Waste Management in Mining and Mineral Processing</i> and not by the NORM Safety Guide which focuses on the handling of relatively low activity materials.</p> <p><u>Corrections</u> (Annex 2 on Bauxite) Page 94, line 3454: Change [2003] to [2007]</p> <p>Page 94, line 3460: Change (62.3 Mt in 2006) to (63.6 Mt in 2006)</p> <p>Page 94, line 3460: Change (18.3 Mt in 2006) to (18.4 Mt in 2006)</p> <p>Page 94, line 3463. Change 44 Mt to 45 Mt</p> <p>Page 94, line 3465, Change 19% to 20%</p> <p>Page 94, line 3466, Change 81% to 80%</p> <p>Page 94, line 3473-4 Delete (also designated red mud)</p> <p>Page 96, line 3505, add to the note "...and are indicative estimates</p>	<p>Support noted.</p> <p>Support noted</p> <p>Reference amended</p> <p>Amended</p> <p>Amended</p> <p>Amended</p> <p>Amended</p> <p>Amended</p> <p>Amended</p>
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	<p>Membership of the Radiation Industry Group consists representatives from processing plants, mineral sands operations, and radiation health experts.</p> <p>General Comments</p> <p>Overall, CME considers that the guide is timely, assisting to inform regulators and industry and educate the general public. The CME supports the approach taken in the guide which makes clear NORM is a natural phenomenon with a range of values of several orders of magnitude, highlighting that NORM is a major component of the 'normal background' radiation to which we are all subjected without harmful health effects observed.</p> <p>The CME supports the aim of this guide to assist those various industries and activities, many of which maintain facilities in several states/territories and also deal internationally, to be aware of and maintain the highest level of radiation safety practice consistent with the recommendations of the International Atomic Energy Agency (IAEA). ARPANSA's role (lines 151-153) is described as the following: "to promote uniformity of radiation protection policy and practices across the jurisdictions of the Commonwealth, states and territories and to provide advice on radiation protection...". CME recommends that the roles and responsibilities of ARPANSA should include reference to IAEA recommendations as in the following: "to promote uniformity of radiation protection policy and practice throughout Australia, in line with IAEA recommendations". In this way, 'internationalisation' of industry practices can be ensured.</p> <p>The CME Radiation Industry Group has recently played a major role in the revision of Western Australia's suite of guidelines for the management of NORM in mining and mineral processing. The new guidelines have now been issued by the Resources Safety Division of the WA Department of Consumer and Employment Protection (DOCEP) under the Mines Safety and Inspection Act 1994 following endorsement by the Mining Industry Advisory Committee. The guidelines describe</p>	<p>Noted</p> <p>Amended to refer to consistency with international best practice</p> <p>Noted.</p>
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¹ http://www.docep.wa.gov.au/resourcesSafety/Content/Mining/Occupational_Health/Occupational_health.html

	<p>acceptable methods for addressing radiation safety requirements and serve to promote uniformity in radiation safety management across exploration, mining and mineral processing. The guidelines are available on the DOCEP website¹.</p> <p>There are 7 guidelines in total which cover the following areas:</p> <ul style="list-style-type: none"> • NORM-1 Applying the system of radiation protection to mining operations • NORM-2 Preparation of a radiation management plan – exploration/mining and processing • NORM-3 Monitoring NORM – pre-operational monitoring requirements /operational monitoring requirements/air monitoring strategies /airborne radioactivity sampling / measurement of particle size • NORM-4 Controlling NORM – dust control strategies/ management of radioactive waste/ transport • NORM-5 Radiation dose assessment • NORM-6 Reporting and notifying • NORM-7 Boswell – assessment and reporting database <p>Specific Comments</p> <p>With specific reference to the draft ARPANSA NORM Safety Guide, the CME would also like to offer the following specific comments for your consideration:</p> <p><u>Comment 1</u> Part 1.2, Line 8 - Background Replace “that exists” with “existing”</p> <p><u>Comment 2</u> Part 1.2 - Background Remove lines 22, 23 and 24, then go directly to Table 1, with Column 5 changed to “Organ(s) that may be at risk” or “Organ(s) at possible risk”.</p> <p><u>Comment 3</u> Part 1.2, Table 2 (Column 5), Table 3 (Column 5) and Table 4 (Column 5)</p>	<p>Text amended</p> <p>Amended to “organs potentially at risk” for this and following tables/text.</p> <p>See above</p>
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	<p>Change to “Organ(s) that may be at risk” or “Organ(s) at possible risk”.</p> <p><u>Comment 4</u> Part 1.2, Background Delete lines 46, 47 &48.</p> <p><u>Comment 5</u> Part 2, Lines 251-263 Reverse the paragraph order.</p> <p><u>Comment 6</u> Part 2.1, Lines 689-692 – Water treatment Whilst it is correct that Ra²²⁸ concentrations tend to be higher than those of Ra²²⁶, this may not be the case in the areas of wide-spread and prolonged fertilizer application, particularly if the fertilizer is imported.</p> <p><u>Comment 7</u> Part 2.5 – Coal extraction and electricity generation It should be noted that with some 100 million tonnes of coal consumed in Australia annually, even at 1ppm Uranium, this would represent 100 T U (primarily U²³⁸) displaced together with the other radionuclides listed.</p> <p><u>Comment 8</u> Part 2.8.1 - (Titanium dioxide pigment production) and 2.8.2 (Zircon refining) It would be worthwhile to reference relevant IAEA Safety Reports.</p> <p><u>Comment 9</u> Part 2.9 - Scrap metal recycling The CME considers that should the scenario of comparatively large scale contaminated scrap metal occur, management would be difficult, as access to radioactive waste repositories does not currently exist.</p> <p><u>Comment 10</u> Part 2, Some industries where radiation protection issues may arise in dealing with NORM CME recommends that a new paragraph “2.13” be inserted, covering</p>	<p>See above</p> <p>See above</p> <p>see Nick Tsurikov’s comments and response</p> <p>This point was made in the RHSAC position paper on NORM. The activity concentration at this level is the same as or slightly lower than natural background levels</p> <p>Agreed – see Nick Tsurikov’s comments and response</p> <p>Noted</p> <p>Thank you. A paragraph has been added. It would seem reasonable to assume at this point in time that any potential problems associated with geothermal</p>
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	<p>“Geothermal Energy Generation”. Using geothermal energy requires drilling deep holes (boreholes) and inserting pipes for pumping high-temperature fluids from the ground. The rocks that contain the high-temperature fluids may also contain minerals, which tend to form a scale inside the pipes and production equipment. If the rocks also contain radionuclides, such as radium, the mineral scale, production sludges, and waste water will contain technologically enhanced naturally occurring radioactive material (TENORM). There are several companies who are looking into the potential for geothermal energy generation both in Western Australia and South Australia and references are available (from the USA) indicating that radiological issues must be considered within this industry.</p> <p><u>Comment 11</u> Part 3.2, Line 781 – Internal exposures This appears to be a misprint: Thoron is actually Rn²²⁰, not Rn²²² as in the text. Through the various different examples for internal radiation pathways, great care must be exercised so as not to exacerbate unnecessary fear.</p> <p><u>Comment 12</u> Part 3.2.2, Line 847 - Direct exposure from radionuclides in landfill CME notes that much of this type of situation could arise in cases of radionuclide contaminated land, generally the subject of separate state/territory legislation, and subject to differing criteria.</p> <p><u>Comment 13</u> Part 3.3.3, Lines 917-918 – Dredging for mineral extraction The following is suggested for insertion after “transport” in line 918: <i>The most common practice is pumping slurry directly to the concentration plant located in the vicinity of the dredge.</i></p> <p><u>Comment 14</u> Part 3.4.3, Line 961 – Radon CME suggests that the word “are” be changed to “may be” in the following sentence: “Therefore the decay products are the major radiological issue...”, as this is not always the case (e.g. downstream processing of zirconium and titanium minerals).</p>	<p>energy generation will be similar to those encountered in the oil and gas industry.</p> <p>Already corrected – see Nick Tsurikov’s comments and response</p> <p>Noted</p> <p>See Nick Tsurikov’s comments and response</p> <p>See Nick Tsurikov’s comments and response</p>
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	<p><u>Comment 15</u> Part 3.5, Lines 976-977 – Transport of bulk commodities... The reference to the IAEA Safety Guide RS-G-1.7 should be deleted from this part as it is specifically stated that this Guide does not apply to transport situations (please see paragraph 1.8 on Page 4 and footnote 8 on page 17 of the RS-G-1.7).</p> <p><u>Comment 16</u> Part 3.7.2, Line 1100 – Utilisation of NORM residues “If an assessment of the potential radiological impact of these situations is to be carried out, then the details of the assessment process may be discussed with the regulator”.</p> <p>The guide should indicate which regulatory bodies are applicable (e.g. environment/mining etc.) and should provide advise to those who may be involved in actions that cross jurisdictional boundaries.</p> <p><u>Comment 17</u> Part 3.8.1, Line 1137 – Storage CME recommends the following insertion after “...buildings,”: “or specifically designed pits at mine sites”.</p> <p><u>Comment 18</u> Part 3.8.2, Lines 1150-1153– Near surface burial CME recommends that this paragraph needs to allude to specific conditions that would need to be placed on a land title such as, for example, - “no excavations deeper than 3 meters”.</p> <p><u>Comment 19</u> Part 3.9, Lines 1161-1163 – Public perception Reference to the following IAEA document is recommended: Communications on nuclear, radiation, transport and waste safety: a practical handbook, IAEA-TECDOC-1076, April 1999.</p> <p><u>Comment 20</u> Part 4.4.6 – NORM management plan (Also mentioned in: 1051-1052, 1458, 1495-1496, 1516-1517, 1584, 2042, 2093, 2096)</p>	<p>See Nick Tsurikov’s comments and response</p> <p>Amended text to indicate that first approach should be to the radiation protection regulator.</p> <p>See Nick Tsurikov’s comments and response</p> <p>This would also be something that would vary from one site to another, depending on the materials being disposed and the anticipated future use of the burial site.</p> <p>See Nick Tsurikov’s comments and response Text already amended</p>
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	<p>The CME considers the creation of the new term “NORM management plan” is unnecessary and would only create further misunderstanding – for industry and its customers and for the general public. It is already difficult to explain why different limits are applicable for workers and the public, doses from radon and other natural sources, there are different levels/limits for the same radionuclide – depending on its origin, ‘natural’ and ‘artificial’, and so on. Therefore, the new term is likely to add more confusion and the CME advocates continued use of the term “radiation management plan”.</p> <p>Furthermore, the creation of this term would most likely create a perception in some industries that any elevated radiation exposures are NORM related and therefore not as serious as ‘radiation problems’. For example, it could be concluded that a material such as zircon sand is less dangerous during its initial processing (such as micronisation and fusion) [NORM management plan] than inside mineral sands processing plants [radiation management plan] – where the opposite is, in fact, the case.</p> <p>The CME recommends that the guide not propose the introduction of specific management plan dealing with NORM and that NORM issues be dealt within the framework of the existing radiation management plans.</p> <p><u>Comment 21</u> Lines 2803-2804, part Glossary CME considers the definition of NORM to be very vague and, in accordance with it, every material at every site/location may be classified as ‘NORM’. The suggestion is to replace this definition with the one from the Guideline on Classification of Radioactively Contaminated Sites (Radiological Council of Western Australia, 2007), which offers a better description of materials to which the draft guide is intended to apply:</p> <p><i>NORM (naturally occurring radioactive material) – Material containing no significant amounts of radionuclides other than naturally occurring radionuclides, disturbed or altered from natural settings, or present in</i></p>	<p>See Nick Tsurikov’s comments and response</p> <p>Amended to clarify that a NMP is only necessary in situations involving NORM, and which are within the scope of this Safety Guide (and for which there is no existing RMP or RWMP). The Working Group does not agree that the use of NMP will create the issues described</p> <p>See Nick Tsurikov’s comments and response– text amended to use the IAEA definition</p>
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	<p><i>technologically enhanced concentrations above background radiation levels due to human activities that may result in a relative increase in radiation exposures and risks to the public and the environment.</i></p> <p><u>Comment 22</u> Lines 3304-3307, part Surface contamination The existence of radiation monitors such as ‘radioisotope identifiers’, which could be helpful in on-site determination of what is in scale/sludge should be mentioned.</p> <p><u>Comment 23</u> Part A1.5.4, Lines 3341-3343 – Issues needing additional consideration The situation with equipment that is ‘NORM-positive’ off-shore and ‘NORM-negative’ on-shore is could be addressed by the setting of company/industry standards for ‘NORM-positive’ levels.</p> <p>For example: General background levels are in order of 0.1 microSv/hour but can be up to 0.2-0.3 microSv/hour. Off-shore, these levels are naturally lower and typically would be in order of 0.02 microSv/hour. If the level from a piece of equipment is in order of 0.25-0.30 microSv/hour (off-shore and on-shore) – it is sufficiently low as to exempt this equipment from any control.</p> <p><u>Comment 24</u> Lines 3708-2709, part A2.4 – Management strategies for each type of residue “Represented in Figure 6” should be replaced by “represented below” as it is not a ‘figure’ as such.</p> <p><u>Comment 25</u> Part A2.4, Lines 3710-3726, 3742-3747 - Management strategies for each type of residue As detailed above (Comment 19), the value of 1 Bq/g may be inappropriate for bulk amounts of material and the value of 1 mSv/year may need to be replaced with 0.3 mSv/year.</p> <p><u>Comment 26</u></p>	<p>See Nick Tsurikov’s comments and response</p> <p>See Nick Tsurikov’s comments and response</p> <p>See Nick Tsurikov’s comments and response</p> <p>See Nick Tsurikov’s comments and response</p>
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	<p>Lines 3785-3788 – ‘the value of 0.3 mSv/year is considered in European Union’ This value has, in fact, been in place in some countries in the EU for some time now and the reviewed Guide also recommends it as the level under which a site can be released from regulatory control (lines 1684-1689).</p> <p><u>Comment 27</u> Annex 3 – Management of NORM in the phosphate industry It is not clear if phosphoric acid is actually produced in Australia and a clarification would be appropriate:</p> <p>Lines 3922-3924: “Phosphoric acid used industrially in Australia is now derived from imported material. For economic reasons, local production of phosphoric acid ceased in the early 1990’s [Chemlink]”.</p> <p>Lines 3992-3994: “To address this shift in demand favouring higher analysis fertiliser, certain Australian manufacturers are producing phosphoric acid to replace sulphuric acid.”</p>	<p>See Nick Tsurikov’s comments and response</p> <p>See Nick Tsurikov’s comments and response</p> <p>Amended to clarify that high purity phosphoric acid is not produced, but lower grade for fertiliser production is still produced.</p>
<p>10 Ryan Gilchrist, ANSTO</p>	<p>Line 14 - Add “half life” in front of “decay times”.</p> <p>Lines 183 & 208 - The first refers to publishing other Annexes separately in the future whilst the second line considers them in future editions.</p> <p>Lines 413–441 - The second sentence (and some later statements in this section) are not consistent with our understanding. The major proportion of copper comes from sulphide deposits (e.g. Olympic Dam and Mt Isa). These deposits are typically copper iron sulphides and may contain, or be associated with, other metals including gold, silver (both in most deposits), lead, zinc (both for example at Mt Isa) and sometimes uranium (as at Olympic Dam). The sulphides must generally be concentrated to pass to the smelting stage for subsequent metal recovery by pyrometallurgical and electrometallurgical processing. Some near surface oxidised deposits contain copper that is recovered</p>	<p>Agreed and amended</p> <p>Agreed – deleted separately from 183 and amended 208.</p> <p>Amended Section 2.4 to incorporate these comments</p>

	<p>by leaching, solvent extraction and electrowinning. Other metals are not present in economic quantities and are not recovered by this technique. After mining and milling of the sulphide ores the copper minerals are separated by flotation to produce a concentrate with a copper content of + or – 30% depending on the mineralogy and efficiency. The concentrate is smelted to remove some of the volatile impurities to a fume and some of the iron plus other impurities to a slag. The copper-iron-sulphur matte produced by smelting is further processed to an impure copper called blister copper. An additional stage of pyrometallurgical refining allows production of anodes which are used to electrorefine the copper to high purity for industrial use. Gold and silver are separated during the electrorefining stage to an anode slime. This slime is further processed for separate recovery of high purity metals.</p> <p>In the case of the Olympic Dam copper-uranium mine both the copper concentrate and the flotation tailings are leached to dissolve uranium which is subsequently recovered by a solvent extraction technique.</p> <p>Line 483 - Replace “into a discharge stack” with “to a gas handling system to separate the fly ash before discharge of the cleaned gas to the stack”.</p> <p>Line 498 - Replace “make” with “making”.</p> <p>Line 506 - Unclear as to what is meant by ‘smaller particles in the stack emissions’. This is implying that dust is being vented up the stack. Shouldn’t the dust be recovered from the gas stream (i.e. the gas handling system to remove particulates) before the gas passes out of the stack?</p> <p>Line 517 - Put “and” before “molten”.</p> <p>Line 532 - Replace “waste gases” with “dusts”.</p> <p>Line 781 - Thoron is ²²⁰Rn.</p>	<p>Agreed and amended</p> <p>Amended</p> <p>Amended</p> <p>Amended</p> <p>Amended</p> <p>Amended</p> <p>Amended</p>
<p>11 Doug Collier, ANSTO</p>	<p>Line 186 is not logical as mineral sands are no different to the many other NORM situations and are very similar to many situations such as NORM in phosphate and rare earth deposits.</p> <p>Line 194 – “tantalum” is not a mineral sand. “ilmenite” would be a better choice of example.</p> <p>Line 414 should read...”..In Australia, an important type of copper</p>	<p>While physically they are no different, the scope of this document does not include them as they are already regulated. This Safety Guide is intended to consider those industries where NORM arises, and where the radioactivity is not extracted for its commercial value.</p> <p>Agreed and amended</p>

	<p>mineral...”</p> <p>Line 425 should read...” remain in the tailings from the flotation cells”</p> <p>Line 434 should read ...”Uranium may be present in significant concentrations closely associated with the copper mineralisation. Partitioning ofin the copper concentrate....” NOT “into”.</p> <p>Line 441”and partition to the slag, dusts and other products of copper smelting”</p> <p>Line 597 WACME What/where is this reference?</p> <p>Line 631 should read ...”in silicate form as the mineral zircon and in.....as baddeleyite.” NOT “ore” – check spelling</p> <p>Line 976-977 is not really to do with transport but rather trading.</p> <p>Line 3474 1 mSv/y is an allowed dose NOT and exemption limit.</p>	<p>This section has been amended</p> <p>Amended</p> <p>Amended</p> <p>Amended</p> <p>See line 2288 of consultation draft</p> <p>Agreed and amended</p> <p>Amended</p> <p>Assume this is line 3747 – amended to dose limit</p>
<p>12 Denis Wymer</p>	<p>Lines 13, 14 “These radionuclides” should be “The parent radionuclides”. Some of the progeny are short lived.</p> <p>Lines 108–110 Uranium in glass is not a contaminant. It is put there deliberately to provide colour.</p> <p>Line 630 The title “Zircon refining” should rather be “Zircon and zirconia production”. Zircon is not refined. It is used either as the silicate (zircon) or oxide (zirconia), neither of which involves a process which would be described as refining.</p> <p>Lines 631–658 This section should make reference to IAEA Safety Report No. 51 for further information (as was done in line 313 for Safety Report No. 34)</p> <p>Lines 976, 977 RS-G-1.7 is not relevant for transport. In fact its scope specifically excludes materials in transport</p> <p>Line 1020 Paints do not contain NORM. Rather refer to “ceramic</p>	<p>Agreed and amended</p> <p>Amended</p> <p>Agreed and amended</p> <p>Agreed and amended</p> <p>Noted. Removed RS-G-1.7 from this section.</p> <p>Amended</p>

	<p>pigments” (these are zirconia pigments used in glazes and colours for the decoration of pottery, ceramic tiles and sanitary ware – they are not paints)</p> <p>Lines 1028–1033 Again, make reference to Safety Report No. 51 for further information</p> <p>Lines 1176–1178 The proceedings of NORM V are about to be published, literally in the next few days. The reference is: International Atomic Energy Agency (2008). Naturally Occurring Radioactive Material (NORM V). International Atomic Energy Agency, Vienna. IAEA Proceedings Series</p> <p>Line 1183 “International guidance recommends....” should be replaced by “International standards require....”</p> <p>Line 1187 The correct reference should be: Food and Agriculture Organization of the United Nations, International Atomic Energy Agency, International Labour Organisation, Nuclear Energy Agency of the OECD, Pan American Health Organization, World Health Organization (1996). International Basic Safety Standards for Protection against Ionizing Radiation and for the Safety of Radiation Sources. International Atomic Energy Agency, Vienna. IAEA Safety Series No. 115. (In any case the reference “IAEA, 2004” does not correspond to any of the references in the reference list, because there are several for 2004)</p> <p>Lines 1275–1279 The levels given in RS-G-1.7 for natural radionuclides are not exclusion levels. Furthermore, there is a serious error with the doses that are quoted – for natural radionuclides, the RS-G-1.7 values correspond to doses that are unlikely to exceed about 1 mSv in a year (and with no mention of a collective dose). It is suggested that the text should be modified to be consistent with that in RS-G-1.7, as follows:</p>	<p>Amended</p> <p>Agreed and amended</p> <p>Legally they cannot “require”.</p> <p>Amended reference to be to the BSS.</p> <p>Agreed and amended.</p>
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	<p>“For normal exposure situations, it is usually unnecessary to regulate materials with radionuclides of natural origin below 1 Bq g-1 [IAEA, 2004a]. Under these conditions, it can be anticipated that doses to members of the public are unlikely to exceed about 1 mSv a-1.”</p> <p>Lines 1280–1284 This statement is wrong. Exclusion depends on amenability to control, not on whether the state of a mineral or other natural material is altered. It is suggested that this be replaced by</p> <p>“Exposure to a mineral deposit or other natural material may be excluded from the scope of regulatory instruments even if its state has been altered by human activities, when such exposure is deemed to be unamenable to control. However, it is appropriate for the regulatory body to take such exposure into consideration if the individual radionuclide concentration in the material exceeds about 1 Bq g-1. Depending on the outcome of a screening assessment negotiated between the operator and the Authority, the activity concerned may be exempted or be subject to regulatory control.”</p> <p>Lines 1292–1297 Even for building materials, a dose criterion of about 1 mSv will still apply, so the word “However” is not really appropriate. It is suggested that the text of this paragraph be modified to read as follows:</p> <p>“The application of the exemption criterion of about 1 mSv, when applied to some situations (such as the use of some building materials containing natural radionuclides), will necessitate consideration by the Authority of some types of regulatory control over exposures from materials due to radionuclides with activity concentrations below those given in Schedule 4 of the National Directory for Radiation Protection (ARPANSA, 2004).”</p> <p>Line 1323 The reference should be IAEA [2006a]</p> <p>Lines 1328, 1329 Reference IAEA [2004] is ambiguous (there are several IAEA references for 2004).</p>	<p>Text amended</p> <p>Text amended</p> <p>Agreed and amended</p> <p>Reference amended to IAEA [2004a]</p>
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	<p>Lines 1475–1481 This paragraph is relevant only to artificial radionuclides. It therefore has no place in this document and should be removed.</p> <p>Line 1548 The reference IAEA, 1995 is an obsolete document and in any case is not relevant to this paragraph. The correct reference should be the Basic Safety Standards (IAEA, 1996) (see comment under Line 1187)</p> <p>Line 1578 The reference IAEA, 1995 is obsolete. The correct reference is the IAEA Safety Fundamentals SF-1 (2006)</p> <p>Line 1621 The publication date of the ICRP 2007 Recommendations is 2008, so the reference should be changed to ICRP, 2008</p> <p>Lines 1639, 1641 The word “limit” should be replaced by “level”? An exemption level is not a limit.</p>	<p>Text removed</p> <p>Agreed and amended</p> <p>Agreed and amended</p> <p>Agreed and amended</p> <p>Agreed. Text amended to “Activity concentration exemption levels”</p>
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